

## THE NECROPHILOUS HABIT IN COLEOPTERA.

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Collectors have long been aware that certain species of beetles may be taken on decomposing carcasses. In fact it is a common procedure to set "traps" for these forms by burying jars with their open ends flush with the surface of the ground and baiting them with scraps of meat.

The beetles thus attracted represent several families phyletically not closely related. In northern Illinois these consist chiefly of Corynetidae, Dermestidae, Nitulidae, Geotrupidae, Trogidae, Copridae, Silphidae, and Histeridae. In number of species all the other families are exceeded by the Histeridae, although Silphidae and Staphylinidae also each constitute over 20% of the species taken.

The families are not, therefore, represented by anything like equal numbers of species. In fact the Nitulidae, if we except the occasional presence of *Ips quadrimaculata*, is represented only by *Omosita colon*.

On the other hand, there is no direct relationship between the number of species in a given family and the actual number of individuals. *Omosita colon* often exceeds in numbers all other species together, and although they represent only 2% of the species, the Dermestidae are often the most numerous necrophilous Coleoptera. The state of the carcass influences the population to some extent, since there is a definite, though not always obvious, ecological succession of species.

But even this succession has no relation to habit. For the skin-consuming Dermestidae may be found on a fresh carcass, while the Trogidae, with similar food habits, seldom occur in numbers before the body is reduced to skin and bones.

Reference has been made to the fact that certain species frequent decomposing flesh only occasionally. Some traps set on the Campus of Ohio State University late in June yielded large numbers of *Patrobis longicornis* and an unidentified species of *Pterostichus*. The only other Coleoptera taken on this occasion were a few specimens of *Necrophorus orbicollis*. In the above example the specimens belonged to a family characteristically predatory and not generally considered necrophilous.

This naturally raises the question as to the food habits of necrophilous Coleoptera. Until a few years ago necrophily and necrophagy were considered mutually inclusive. Necrophagy in any given species was often assumed on the basis of the casual observation that the species was necrophilous. It is the business

of this paper to point out that necrophily does not necessarily indicate necrophagy, and that the explanation of necrophily does not hinge upon the use of decaying flesh as food. With this in view, let us consider the food habits of the various families of Coleoptera represented by necrophilous species.

Although a few Histeridae are found beneath the bark of trees, the bulk of the family is necrophilous. Fabre (1922) observed that the adult Saprini feed on fly maggots. This has also been my experience with a variety of Histeridae. The beetles, often several at a time, attack the maggot, chew a small opening in the skin, and extract the soft parts, leaving the empty skin with only a small hole to indicate how the insect was destroyed. Although I have never seen the larval Histeridae attack maggots, some fly maggots placed with the larvae of *Saprinus lugens*, with no possible way of escape, successively disappeared. This larva will also eat fresh beef, however, when no other food is present.

The Silphidae are chiefly necrophagous. Heymons, Lengerken, and Bayern (1926) have bred the larvae of *Silpha obscura* entirely on flesh. The adults of the same species feed on vegetation, often becoming a serious pest of garden truck. The adults kept in my cages were never observed to eat anything but meat. As Pukowski (1933) has shown, the Necrophori larvae are strictly necrophagous, and the adults are chiefly so. Steele (1927) has observed adults feeding on maggots, and those in my cages often became cannibalistic. But as Pukowski has shown, the adults will attack any large insect that approaches the material they are preparing for their progeny.

The Corynetidae are strictly necrophagous, in spite of the predacious habits of the closely related Cleridae. My specimens of *Necrobia rufipes*, both larvae and adults, thrived on the dried skins of birds.

The Dermestidae are capable of living on dried skin alone. *Dermestes caninus* may be easily bred on almost any kind of dried animal matter.

According to Fabre (1922), the Trogidae have food habits similar to those of the Dermestidae. This seems likely, for although I have not bred any species of this family, they were always found associated with dried carcasses of which only the skin, fur, feathers, etc., remained.

*Omosita colon*, belonging to a family of beetles which are predominantly sap-feeders, was bred by Eichelbaum (1903) on decaying flesh.

The Geotrupidae and the onthophagid Copridae were once classed with the Scarabaeidae. They have diverged in habit from

their relatives by becoming coprophagous. The Onthophagi, notably *Onthophagus janus*, are known to feed on fresh fungi. Their mouth-parts are not fitted for predatory activities, and Vaternahm (1924) has demonstrated that *Geotrupes* do not depend for their nourishment, as was once supposed, on micro-organisms. Specimens of *Geotrupes splendidus*, kept in my cages, were observed feeding on decaying flesh. But on the whole, the Copridae and Geotrupidae cannot be considered necrophagous.

The studies of Voris (1934) indicate that the Staphylinidae, with the possible exception of some termitophilous and myrmecophilous forms, are predominantly predacious. Even the so-called "parasitic" species, though indubitably on the way towards true parasitism, still retain the characteristics of flesh feeders. All species which have come under my observation are predacious; *Creophilus villosus* which was bred from the egg is even cannibalistic in both the larval and adult stages. The chief food of the larger species of Staphylinidae is fly maggots. Adult beetles do sometimes feed on decaying flesh, but this is certainly not their preferred diet.

Of the nine families of necrophilous Coleoptera found in North Temperate America, one (Staphylinidae) is at least generally predacious; two (Histeridae and Silphidae) are partially so; two (Copridae and Geotrupidae) are coprophagous and saprophagous; three (Corynetidae, Trogidae, and Dermestidae) are strictly necrophagous; while finally, the sap-feeding Nitulidae are represented by one strictly necrophagous species. To this list might be added certain species of Carabidae which are only occasionally necrophilous and always, of course, predacious.

The necrophilous habit is unquestionably adaptive, but its adaptive characteristic does not depend upon necrophagy. A decaying carcass represents a concentrated and readily available, if temporary, food supply. But all of the necrophilous Coleoptera do not depend primarily upon the carcass; many depend upon other insects (such as fly maggots) which usually occur in such places.

There is no indication that predacious habits become necrophagous, although there is some indication that necrophagous forms may be predacious. Even this may not have any evolutionary significance. No doubt a more careful study of necrophilous Coleoptera will reveal characteristics common to all. One of these is the very rapid development of the larvae; another is the ability of the adults to detect and follow the slightest odor of decaying flesh. Despite the fact that they are not closely related taxonomically, these insects have gained over their competitors by taking advantage, in one way or another, of the readily available food supply represented by carrion.